

The potential of the ERATOSTHENES ACTRIS CARO NF in the EMMENA region: First observations during EarthCARE overpasses over Cyprus

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The Cyprus Aerosol Remote Sensing Observatory (CARO) National Facility (NF) of the ERATOSTHENES Centre of Excellence (ECoE) at Limassol, Cyprus [34.67° N, 33.04°E] participate in the validation activities of the EarthCARE (EC) mission commissioning phase in the framework of the EVID39:CORAL project. Limassol site offer data of interest for the validation of EC products.

Cyprus unique location reflects the meteorological conditions and coastal dynamics of the broader EMMENA area, making Limassol an exceptional natural laboratory for advanced research on climate change, ACP interactions, and the interlinked dynamics of weather, precipitation, and aridity.



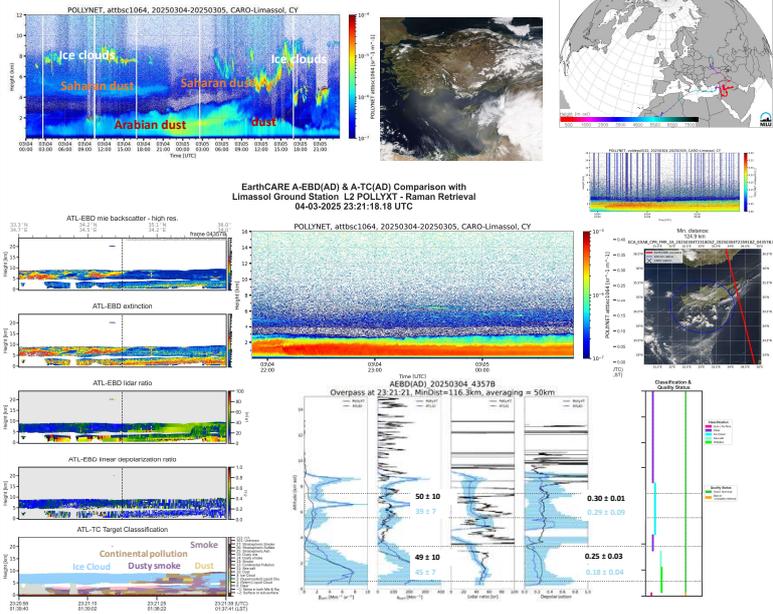
The observatories are equipped with aerosol and cloud remote sensing instruments running continuously.

Table 1: Instruments deployed at LIM observatories for the EC VAL

Limassol - CARO
PollyXT
AERONET photometer
Wind lidar
Cloud Doppler Radar 35GHz
CHM15k ceilometer
Disdrometer
MWR HATPRO RPG
All sky camera
Pyranometer
Spectrophotometer

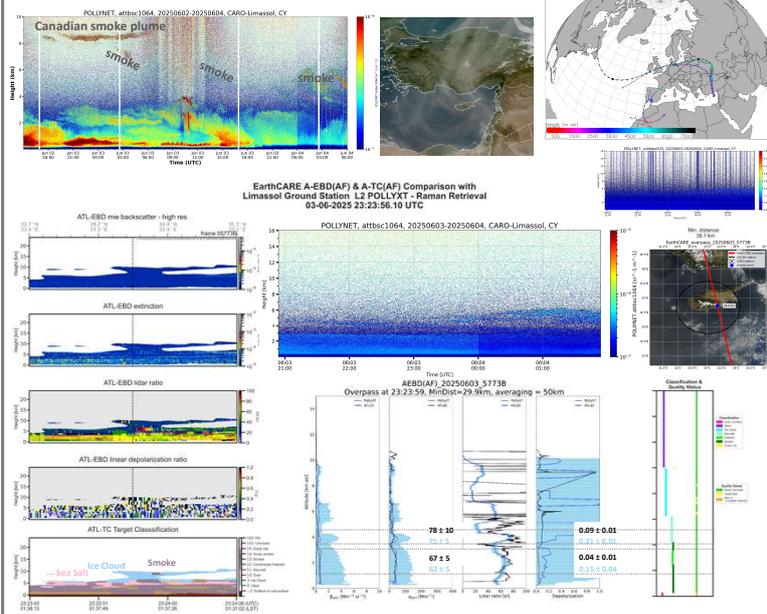


DUST EVENT: High Depolarizing targets



- ◆ **Intensive parameters**
 - Good agreement in the 2–5 km altitude range.
 - ATLID slightly underestimates backscatter near surface (<2 km) and around 7 km.
 - Elevated aerosol layer near 7–8 km detected by both systems with consistent shape.
 - ATLID and PollyXT extinction profiles generally agree up to ~8 km.
- ◆ **Lidar Ratio**
 - ATLID lidar ratio shows smoother profile compared to noisier PollyXT retrievals.
 - Reasonable correlation in aerosol layers, but ATLID may overestimate lidar ratio at low altitudes.
 - Discrepancies in the upper layer between 5–7km are observed in the lidar ratio probably due to the observation of different dust plumes. The ATLID layers originate by Middle East although the PollyXT layer from Saharan.
- ◆ **Depolarization Ratio**
 - ATLID shows lower depolarization values overall—potential bias or calibration effect.
 - High-depolarization layer near 4–5 km likely indicating **non-spherical particles** (e.g., dust) well identified by both instruments.
- ◆ **Aerosol Target classification**
 - ATLID misclassified the aerosol layers showing a difficulty to characterize pure lofted homogeneous dust layer

SMOKE PLUMES: Low Depolarizing targets



- ◆ **Intensive parameters**
 - Both instruments detect two primary aerosol layers at ~2 km and 5–6 km a.s.l., with a weaker signal near 8 km.
 - ATLID shows better agreement with PollyXT up to 2 km likely due to the closer distance.
- ◆ **Lidar Ratio**
 - ATLID's lidar ratio is smoother but captures key features:
 - ~50–60 sr at 2–4 km (likely mixed urban/aqueous aerosols).
 - ~60–80 sr at 5–7 km (consistent with pollution or smoke).
 - PollyXT shows higher variability, but peak values match ATLID within uncertainty.
- ◆ **Depolarization Ratio**
 - PollyXT identify a non-depolarizing layer at 4–6 km ($\delta \sim 0.08-0.1$), indicative of fine spherical particles (e.g., smoke).
 - ATLID's depolarization is systematically higher than PollyXT's (e.g., 0.3 vs 0.1 at peaks)
 - A weak depolarizing signal at 8 km in ATLID is absent in PollyXT, possibly due to SNR limits.
- ◆ **Aerosol Target classification**
 - The layer at 8km characterized as Ice Cloud although the CPR didn't capture any Cloud structure. The smoke layers at 4km captured by ATLID with misclassified areas as sea salt